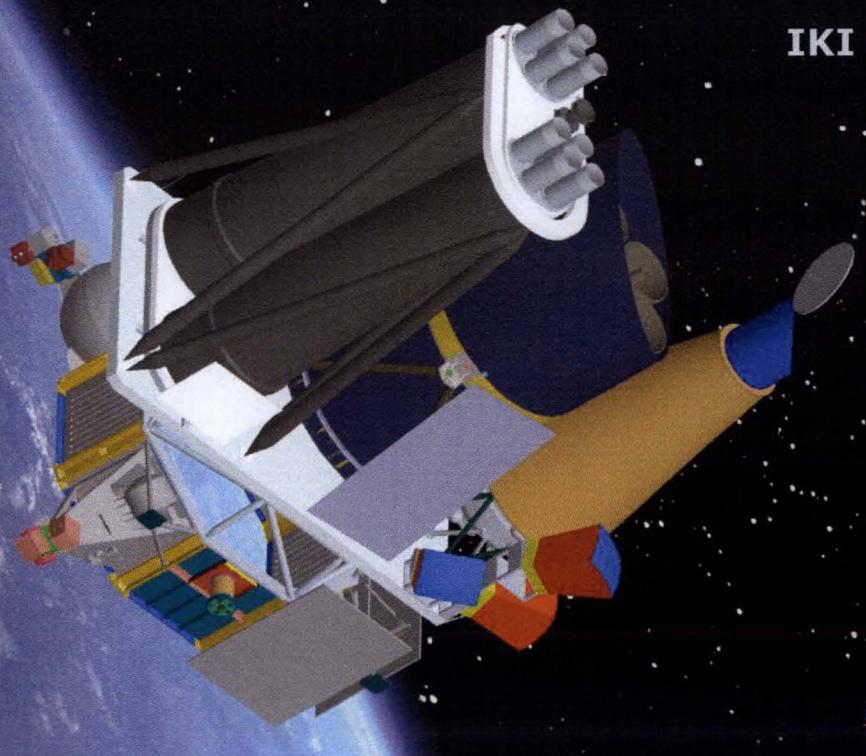
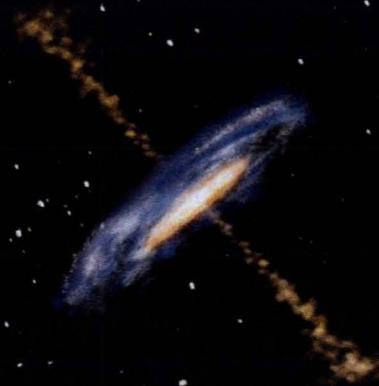


# ART: Surveying the Local Universe at 2-11 keV



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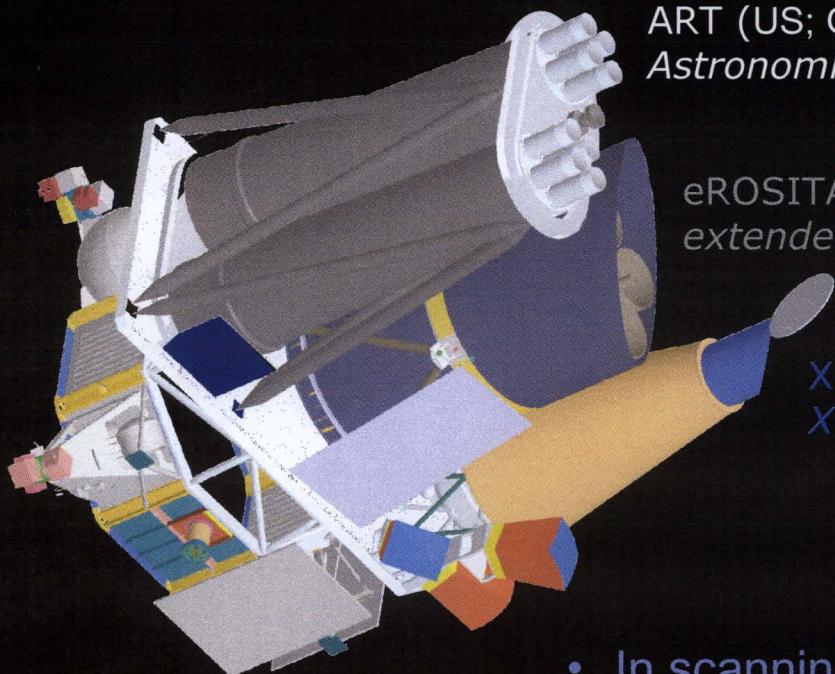
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**Penn State** W.N. Brandt

**Yale** C.M. Urry



# *Spectrum Röntgen Gamma (SRG) is a new, Russian-led x-ray astronomy mission.*



ART (US; Germany; Russia)  
*Astronomical Röntgen Telescope*

eROSITA (Germany)  
*extended RÖntgen Survey with an Imaging Telescope Array*

XRS (Japan & US; Germany)  
*X-Ray Spectrometer*

- In scanning mode, SRG will perform an all-sky survey of unprecedented sensitivity, with CCD energy resolution.
- In pointed mode, SRG will obtain long exposures, with microcalorimeter energy resolution.

# ART is a medium-energy x-ray telescope system for SRG, proposed as a 3-nation collaboration.

## Mirror assembly

2x4 modules of electroformed-Ni shells

US (NASA/MSFC & SAO, proposed)

Russia (VNIIFR)

## Optical bench and alignment

Russia (IKI)

## Focal-plane detectors

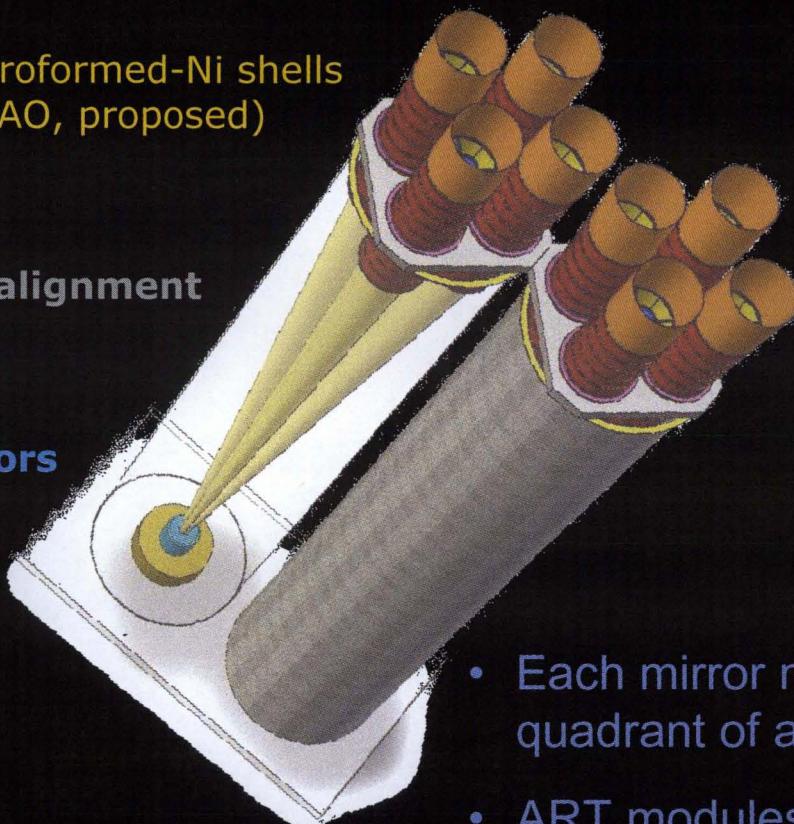
2 eROSITA CCDs

Back-illuminated pn

50-ms integration

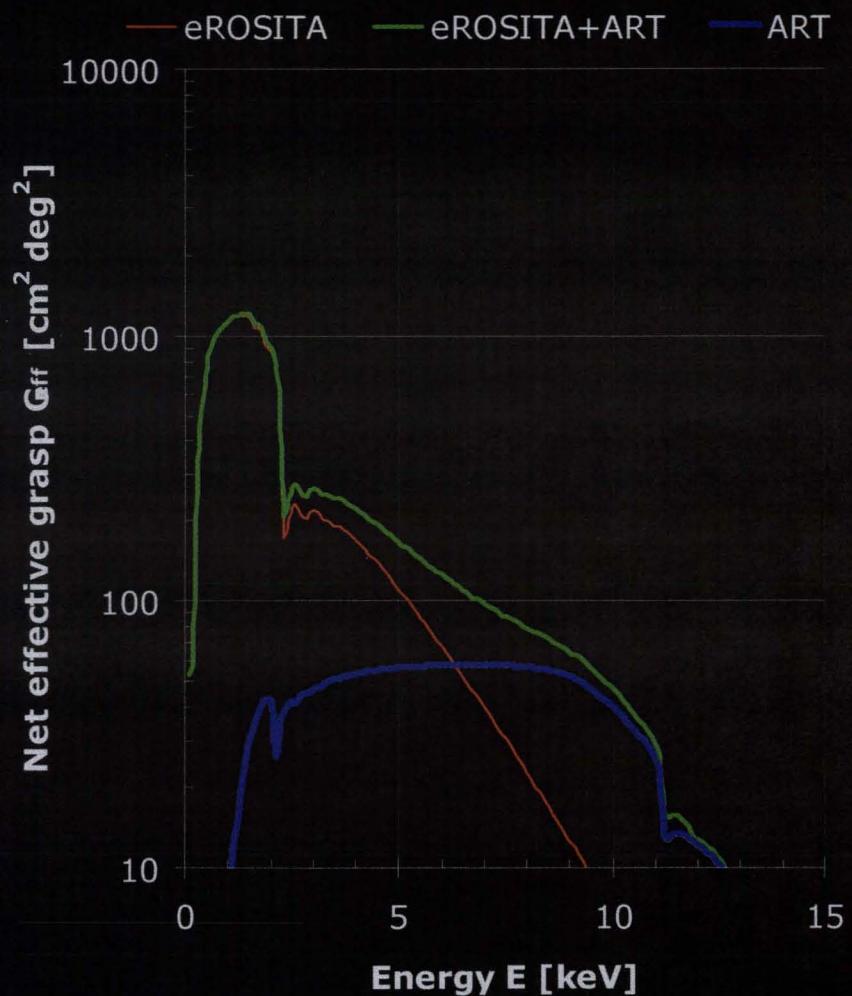
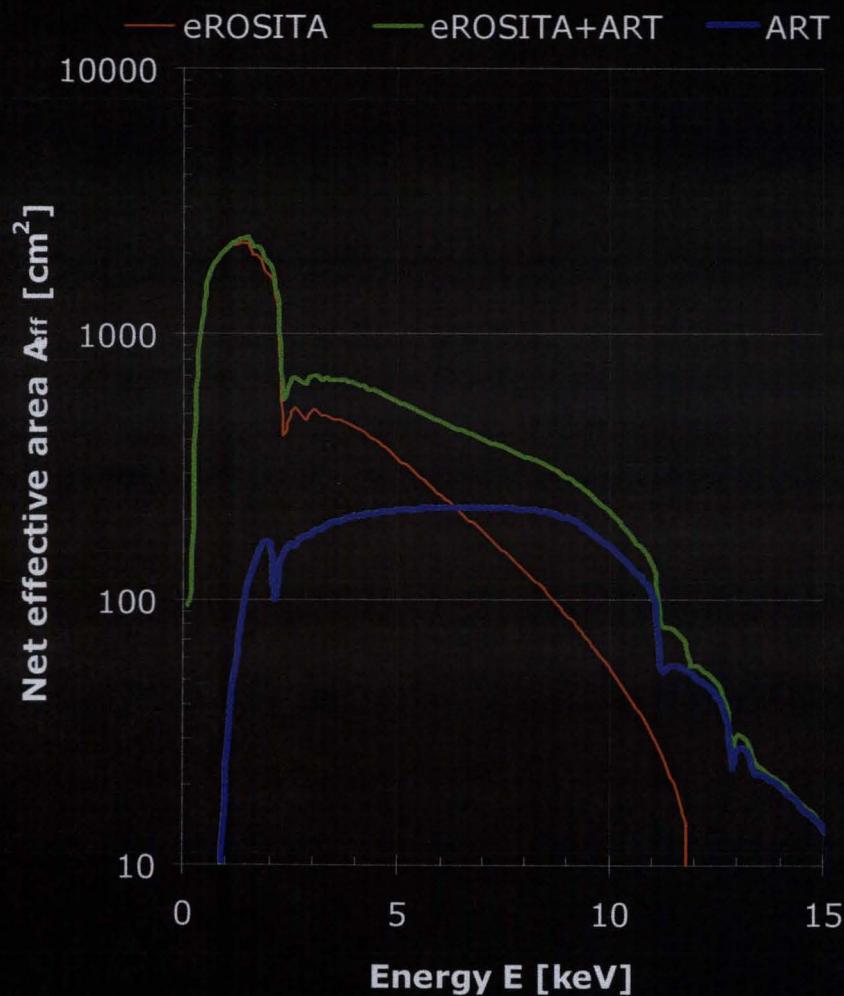
450- $\mu$ m depletion

Germany (MPE)



- Each mirror module images onto a distinct quadrant of a CCD.
- ART modules point 3° from mean direction.
- Align 1 pair of modules to eROSITA & SRG.

ART extends the spectral coverage of eROSITA to 11 keV (15 keV for pointed observations).



# This extended coverage increases detections of Fe-K lines by 3, heavily obscured AGN by 3–5.

ART will detect nearly 100,000 AGN >2 keV.

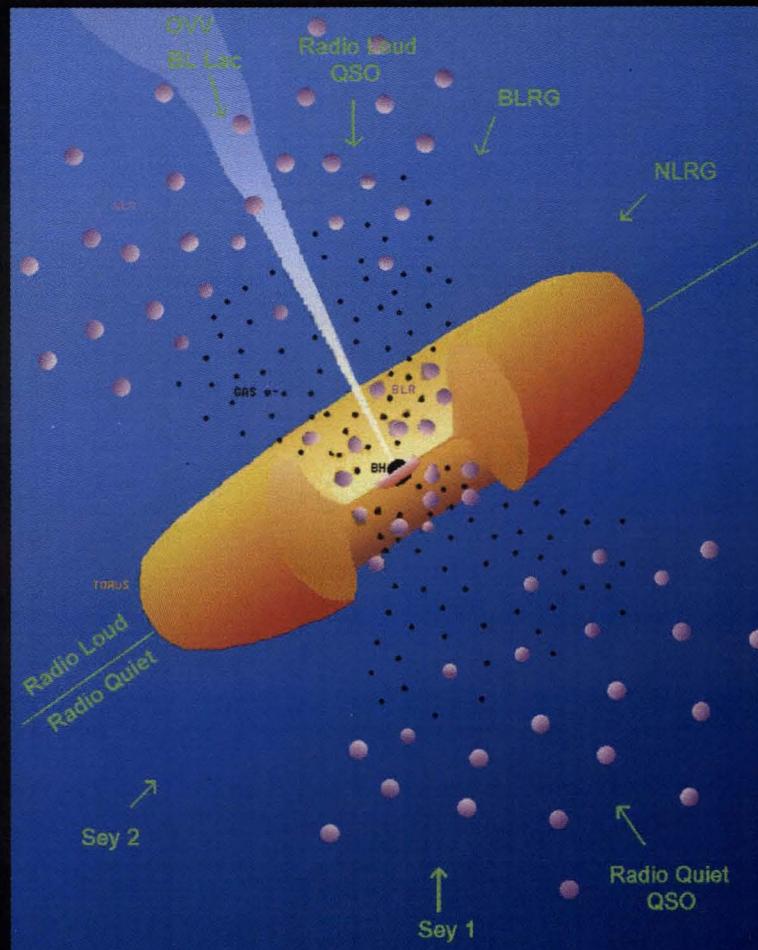
| SRG ART                                 | All-sky               | Polar                 | Point               |
|---|-----------------------|-----------------------|---------------------|
| Survey $\Omega$ [deg $^2$ ]             | 41,000                | 400                   | 125                 |
| Sensitivity [erg cm $^{-2}$ s $^{-1}$ ] | $3.1 \times 10^{-13}$ | $3.4 \times 10^{-14}$ | $8 \times 10^{-15}$ |
| Detected #                              | 52,000                | 14,000                | 31,000              |
| # > 100 cts                             | 1,000                 | 310                   | 3,100               |

eROSITA will detect many more soft sources.

Expected all-sky detections of obscured AGN

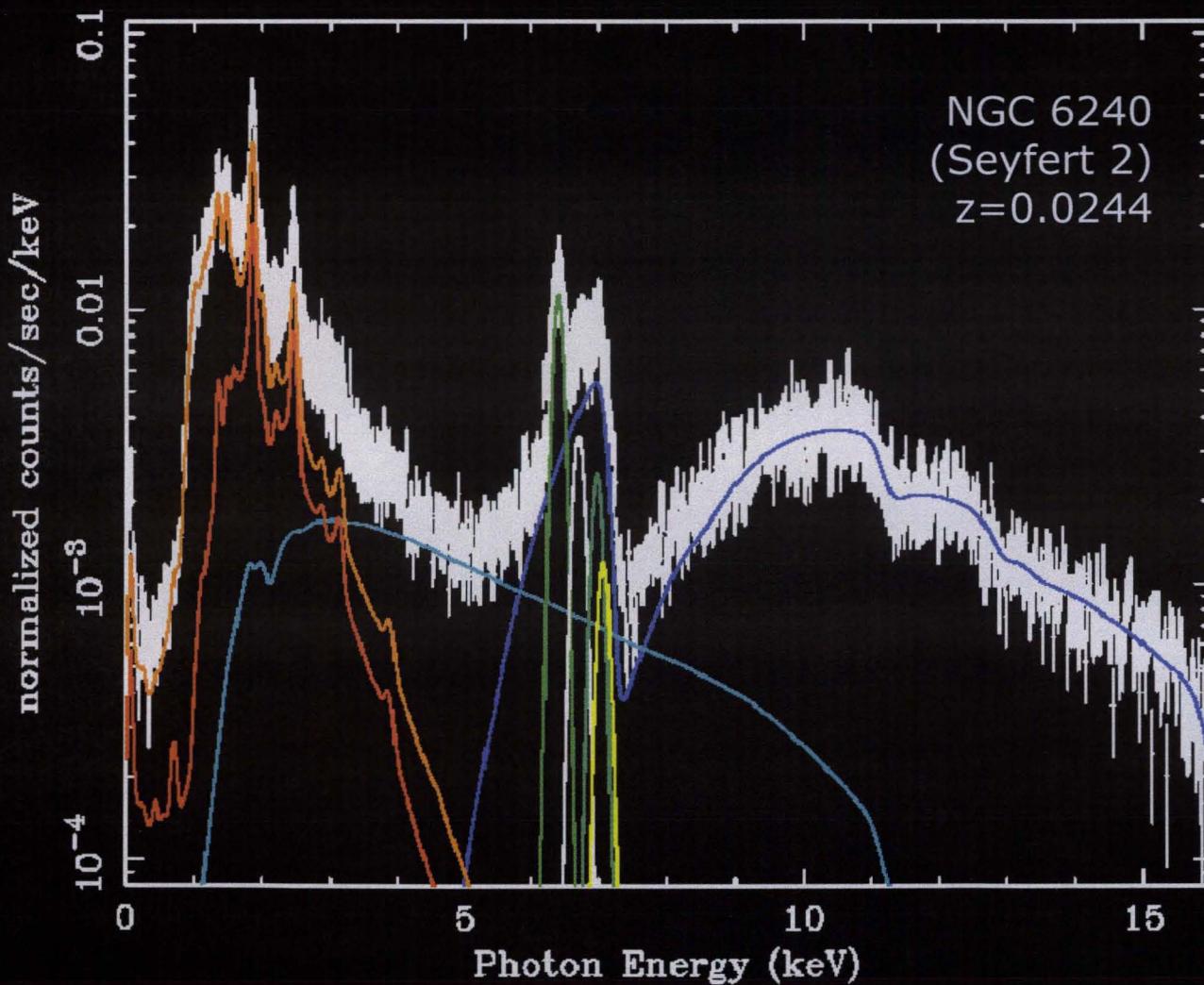
| Column $N_{\text{H}}$ [cm $^{-2}$ ] | eROSITA alone | ART alone | eROSITA +ART |
|-------------------------------------|---------------|-----------|--------------|
| $> 1 \times 10^{23}$                | 5000          | 3000      | 12,000       |
| $> 3 \times 10^{23}$                | 600           | 700       | 1,800        |
| $> 1 \times 10^{24}$                | 20            | 60        | 100          |

Estimates are based upon Treister & Urry 2005.



Urry & Padovani 1995

ART bridges the soft- and hard-X-ray bands, complementing other missions—e.g., NuSTAR.



ART response for  
model spectrum  
(Vignati et al. 1999)

Transparent thermal:  
0.5 keV  
0.7 keV

Fe-K lines:  
neutral fluorescence  
helium-like  
hydrogen-like

Compton-reflected  
power law

Heavily-absorbed  
( $N_H = 2 \times 10^{24} \text{ cm}^{-2}$ )  
power law ( $\Gamma = 1.8$ )